

**What is claimed is:**

1. A multi-mode communication device comprising:

a first switch for receiving an analog signal;

5 a delta-sigma modulator for sampling the analog signal inputted through the first switch when operating in a first mode;

an analog-to-digital converter for sampling the analog signal inputted through the first switch when operating in a second mode;

10 a second switch for selectively receiving an output of the delta-sigma modulator and an output of the analog-to-digital converter;

a plurality of sequential convolution modules for multiplying filter factors by the output of the delta-sigma modulator in the first mode to generate first-mode waveforms, and multiplying PN codes by the output of the analog-to-digital converter in the second mode to generate second-mode output waveforms; and

15 a selection unit for delaying outputs of the sequential convolution modules by a predetermined time in the first mode to restore first-mode output waveforms.

2. The multi-mode communication device of claim 1, wherein each of the sequential convolution modules includes:

20 a memory for storing the filter factors;

a third switch for selectively receiving the filter factors and the output of the analog-to-digital converter according to the first mode or the second mode;

a PN code generator for generating PN codes in the second mode;

25 a fourth switch for selectively receiving the output of the delta-sigma modulator and the PN codes according to the first mode or the second mode;

a multiplier for multiplying the filter factors with the output of the delta-sigma modulator in the first mode, and for multiplying the output of the analog-to-digital converter by the PN codes in the second mode; and

an accumulator for accumulating the outputs of the multiplier to generate output waveforms.

3. The multi-mode communication device of claim 1, wherein the first mode and the second mode are GSM mode and WCDMA mode, respectively.

4. The multi-mode communication device of claim 1, wherein the filter factors are factors of a first-mode low pass filter.

5. The multi-mode communication device of claim 2, wherein the memory is a ROM.

6. The multi-mode communication device of claim 3, wherein the output of the delta-sigma modulator is 1 bit, the output of the PN code generator is 8 bits, and the filter factors are 8 bits.

7. A multi-mode communication device operable in a first mode and a second mode, comprising:

switching means for switching received analog signal to a delta-sigma modulator in the first mode and to an analog-to-digital converter in the second mode;

convolution modules for multiplying filter factors with the output of the delta-sigma modulator in the first mode to generate first-mode waveforms, and multiplying PN codes with

the output of the analog-to-digital converter in the second mode to generate second-mode output waveforms; and

output means for outputting the first-mode waveforms after a predetermined delay in the first mode to restore first-mode output waveforms and outputting the second-mode output waveforms without the predetermined delay in the second mode.

8. The multi-mode communication device of claim 7, wherein each of the convolution modules includes:

a memory for storing the filter factors;

a third switch for selectively receiving the filter factors and the output of the analog-to-digital converter according to the first mode or the second mode;

a PN code generator for generating PN codes in the second mode;

a fourth switch for selectively receiving the output of the delta-sigma modulator and the PN codes according to the first mode or the second mode;

a multiplier for multiplying the filter factors with the output of the delta-sigma modulator in the first mode, and for multiplying the output of the analog-to-digital converter by the PN codes in the second mode; and

an accumulator for accumulating the outputs of the multiplier to generate output waveforms.

9. The multi-mode communication device of claim 7, wherein the analog signal received in the first mode is GSM signal and in the second mode is WCDMA signal.

10. The multi-mode communication device of claim 7, wherein the filter factors are factors of a first-mode low pass filter.

11. The multi-mode communication device of claim 8, wherein the memory is a ROM.

12. The multi-mode communication device of claim 7, wherein the output of the delta-sigma modulator is 1 bit, the output of the PN code generator is n bits, and the filter factors are n bits, n being a multiple of 2.

13. A method of operating a multi-mode communication device comprising:  
sampling an analog signal in a delta-sigma modulator when operating in a first mode;  
sampling the analog signal in an analog-to-digital converter when operating in a second mode;

multiplying the output of the delta-sigma modulator with filter factors in the first mode to generate first-mode waveforms, and multiplying the output of the analog-to-digital converter with PN codes in the second mode to generate second-mode output waveforms; and  
outputting the product in the first mode after a predetermined time delay and the product in the second mode without the predetermined time delay.